

REMARKS

Reconsideration of this application courteously is solicited. By this paper, claims 2-7, 15-18, and 20 have been canceled. Claims 8, 9, 13, and 23 have been amended. Care has been taken to avoid the introduction of any new matter.

The Examiner's grant of an interview of November 2, 2011 has been appreciated. It is believed by the undersigned that the interview, and this paper, resolve all issues raised in the July 12, 2011 Action. Initially, of the several rejections asserted in the July 12th Action, all of those that do not involve independent claim 8 or independent 9 directly have been made moot hereby through cancellation. Accordingly, as was the focus during the interview, focus here will be made on the rejections stated in numbered item 8 in the July 12th Action, namely, to claims 8 and 11-14 as allegedly obvious over Powell in view of Chen, and numbered item 10 to claims 9, 10, and 21-24 as allegedly obvious over Powell and Chen, further in view of Sneh. In connection with these rejections, the rejection in numbered item 9 of claim 14 over Powell, Chen, and Fair, and that in numbered item 11 to claim 24 over Powell, Sneh, Chen, and Fair also are noted. In view of the discussions during the interview, each of these rejections respectfully is submitted as overcome.

During the interview, the undersigned made reference to paragraph [0054] of Chen which defines a "deposition cycle" for copper deposition. This paragraph refers to Chen's Fig. 4. Fig. 4 shows a purge step 304, a copper precursor introduction step 306, another purge gas introduction step 307, and finally a reducing gas introduction step 308. As clear from decision step 310, Chen's steps 304 through 308 are repeated until a copper film of a predetermined thickness is achieved.

It also was discussed that Chen teaches a variety of options for the duration of each of steps 304 through 308, and that the duration of each step can be varied from cycle to cycle, that is successive repetition of steps 304 through 308. For instance, paragraph [0060] discusses that the duration of each pulse of the reducing gas can be different between one deposition cycle, C₁, and next successive deposition cycle, C₂. That is, from cycle to cycle, the reducing gas pulse

duration can be the same or can be different. This is not what is required by Applicants' independent claims 8 and 9.

As also discussed at length during the interview, each of claims 8 and 9 describes Applicants' deposition method as divided into a "first film deposition period", and a "second film deposition period". Claims 8 and 9 have been amended to clarify that each of these two periods includes multiple deposition cycles. Consistent with the definition of a "deposition cycle" from Chen, claim 8, for example, recites alternating steps of supplying a Cu-containing source material, and supplying a reductive gas (after the supply of the Cu-containing source material has been terminated). This alternate application of Cu-containing source material and reductive gas corresponds to Chen's steps 306 and 308. Then, according to the definition of the "first film deposition period" in claim 8, the alternating Cu-containing source material and reductive gas introduction steps, i.e. deposition cycle, must be performed two or more times. Likewise, during the "second film deposition period" of claim 8, such alternating two steps again must be performed two or more times.

With reference to Applicants' Fig. 4, three deposition cycles are shown during Applicants' first film deposition period, and at least five such cycles are shown during Applicants' second deposition period. As clear from Applicants' Fig. 4 and the corresponding text, each of Applicants' deposition cycles is much like those of Chen. Consider the first film deposition period shown in Fig. 4. Step S11 shows supply of the Cu-containing source material. This is followed by purging gas step S12. Thereafter, during step S13, reductive gas is introduced for a duration T1 (while no Cu-containing source material gas is supplied). Step S13 is followed by another purging step S14. Thereafter, the four-step deposition cycle repeats with another source material supply step S11 beginning at the end of step S14.

The second film deposition period is similar to that which occurs during the first such period. It likewise is a four-step deposition cycle beginning with source material supply at S21, followed by purging at S22, followed by reductive gas introduction at S23, again followed by purging at S24. The key difference between the first and second deposition periods is emphasized in each of claims 8 and 9. That is, the duration of reductive gas supply, T2, is shorter

during the second film deposition period, than it is during the first such deposition period. That is, T2 is less than T1. This is consistent between each of independent claims 8 and 9.

Applicants state the reasons for this distinct difference between durations T1 and T2. As Applicants' specification explains, during the first deposition period, the Cu film is just beginning to establish. In order to ensure that the film adheres properly, and has acceptable smoothness, the reductive gas pulse duration must be relatively long. On the other hand, after a good quality Cu film has begun to establish, then, Applicants' claimed processes enter their second film deposition period where Applicants have found that it is no longer necessary to supply reductive gas for the relatively long duration, and instead, shorten the pulse duration. This accomplishes Applicants' other objective in reducing the overall time in Cu film deposition, and thereby increasing throughput.

None of this is taught or suggested by any of the combinations of patent documents asserted in the rejections of claims 8 and 9, and their respective dependent claims. That is, none of Powell, Chen, Sneh, and/or Fair teaches or suggests, to those of ordinary skill in the art, Applicants' grouping of multiple deposition cycles of one type into a first film deposition, for the purpose of establishing a high quality Cu film, and grouping multiple deposition cycles of another type into a second film deposition period, for the purpose of accelerating the overall film deposition process. For at these reasons, Applicants courteously urge that all of the rejections pertaining to independent claims 8 and 9 in the July 12th Action are overcome. Withdrawal of each courteously is solicited.

If any other fees under 37 C.F.R. §§1.16 or 1.17 are due in connection with this filing, please charge the fees to Deposit Account No. 02-4300; Order No. **033082 M 343**. If an extension of time under 37 C.F.R. § 1.136 is necessary that is not accounted for in the papers filed herewith, such an extension is requested. The extension fee should be charged to Deposit Account No. 02-4300; Order No. **033082 M 343**.

Respectfully submitted,
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